

PathOpt – network typology optimization tool

Hubs4Circularity Community of Practice Webinar
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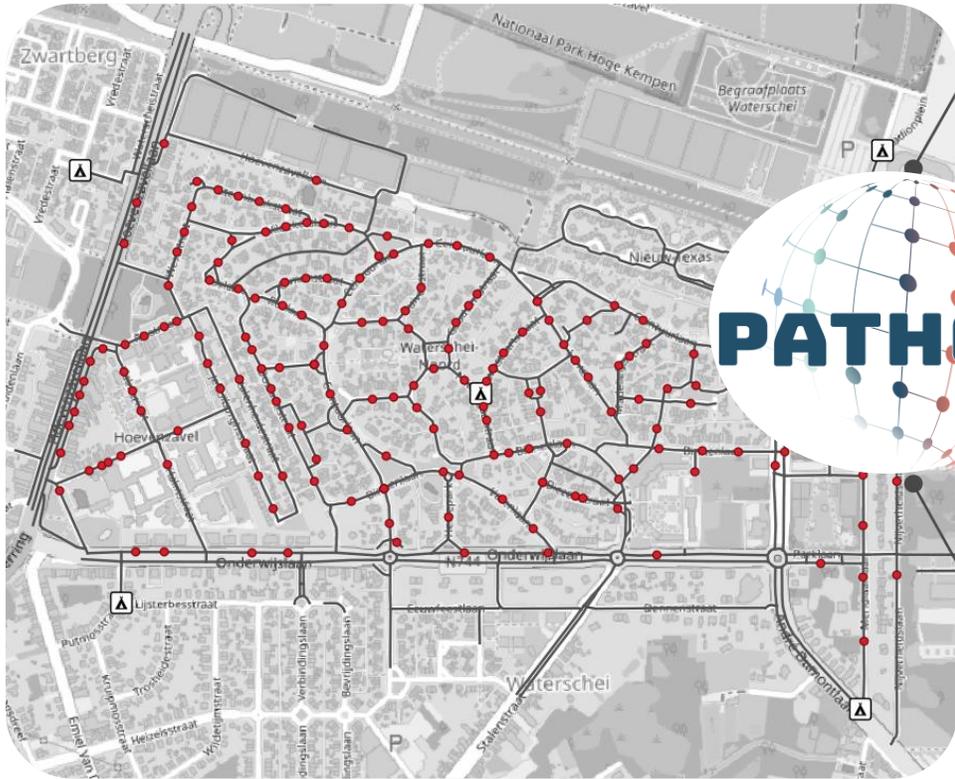
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HURRICANE is funded under the call HORIZON-CL4-2023-TWIN-TRANSITION-01-37 within Horizon Europe, the European Union's framework programme for research and innovation (grant agreement no.:101138494)

PathOpt – What is it?

Accurate (non-linear Physics)

Fast & Scalable (adjoint-based)



Optimized Network Layout
Efficient design for minimal cost.

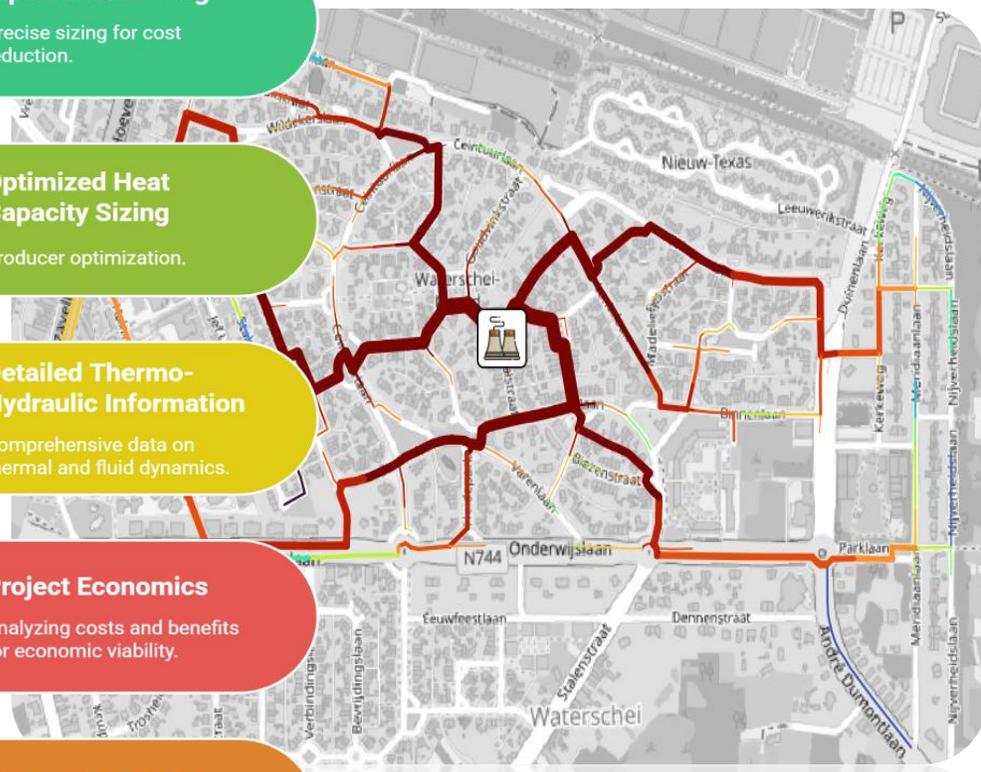
Pipe Dimensioning
Precise sizing for cost reduction.

Optimized Heat Capacity Sizing
Producer optimization.

Detailed Thermo-Hydraulic Information
Comprehensive data on thermal and fluid dynamics.

Project Economics
Analyzing costs and benefits for economic viability.

Seasonal Variations
Understanding and adapting to seasonal heat changes.



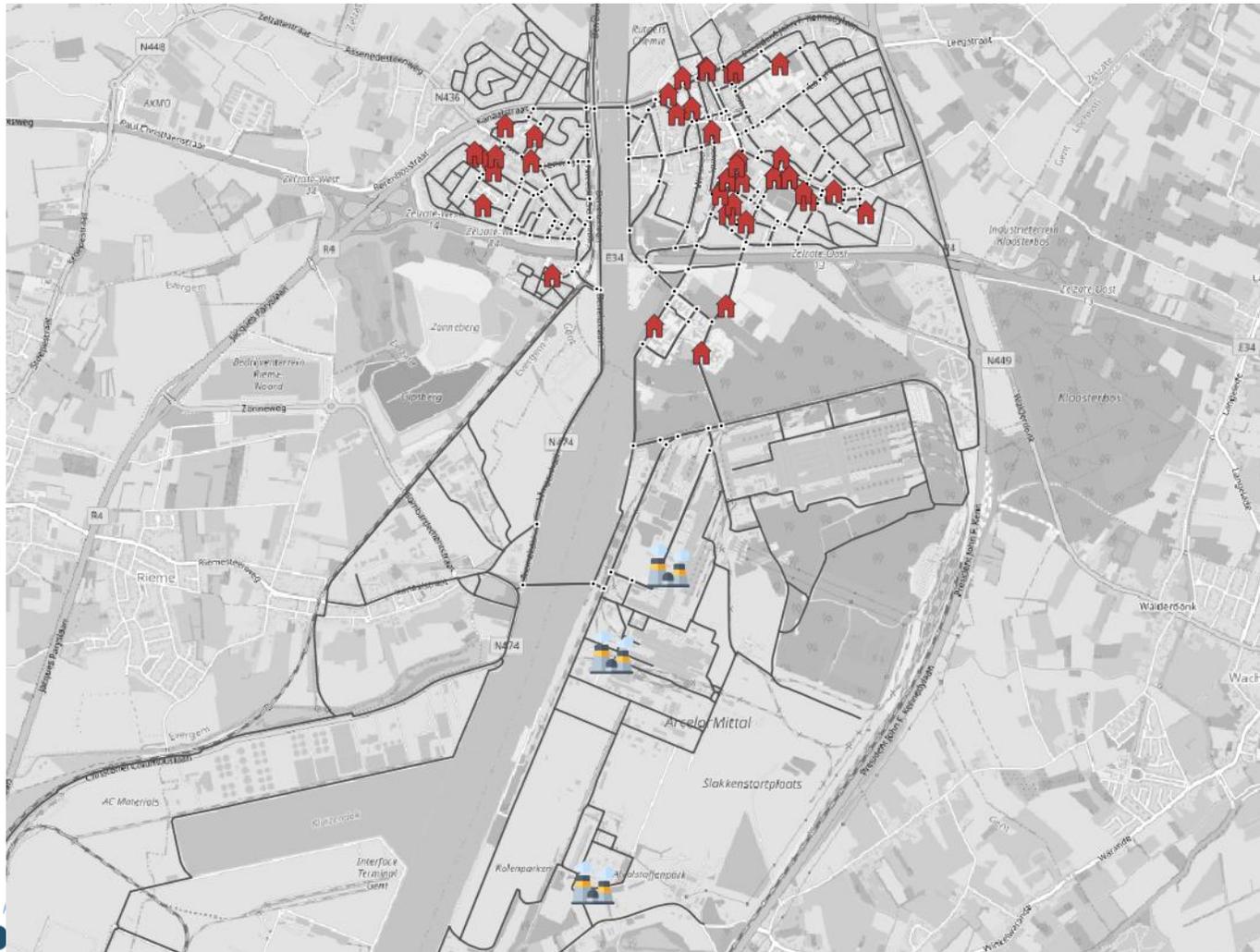
PathOpt – What happened in HURRICANE so far?



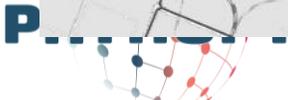
- Additional developments
 - Front-end:
 - Improved input processing
 - Additional integration of existing online databases (such as OpenStreetMap...)
 - Back-end:
 - Improved algorithm robustness
 - Including dynamic and temporal behaviour of producers and consumers
 - Ongoing: inclusion of energy storages, coupling to other energy carriers
- Scenario analyses for excess heat delivery of ArcelorMittal Belgium to surrounding municipality of Zelzate, north of the site



PathOpt – inputs



- Possible routing options from OSM
 - Removed: roundabouts, multi-lane road, cul-de-sacs...
 - Added: potential canal crossings, additional options
- Potential consumers for the DH network
 - 27 larger consumers
 - Mostly public buildings
 - 6.2 GWh (~470 eq. households)
 - 2.8 MW peak power
- 3 potential sources of heat
 - Walking beam furnace of the hot rolling mill: 70°C
 - Blast furnace granulation tower: 70-75°C
 - Cokes factory: circa 55°C
 - In total: 6.6 MW available



PathOpt – scenario variation



Scenario variation

2A: right + left bank canal, 100% connectivity

3: only right bank canal , 100% connectivity

4: only left bank canal , 100% connectivity

5: right + left bank canal, 50% connectivity (random)

6: incl. STORM – all buildings 20% reduction in peak power

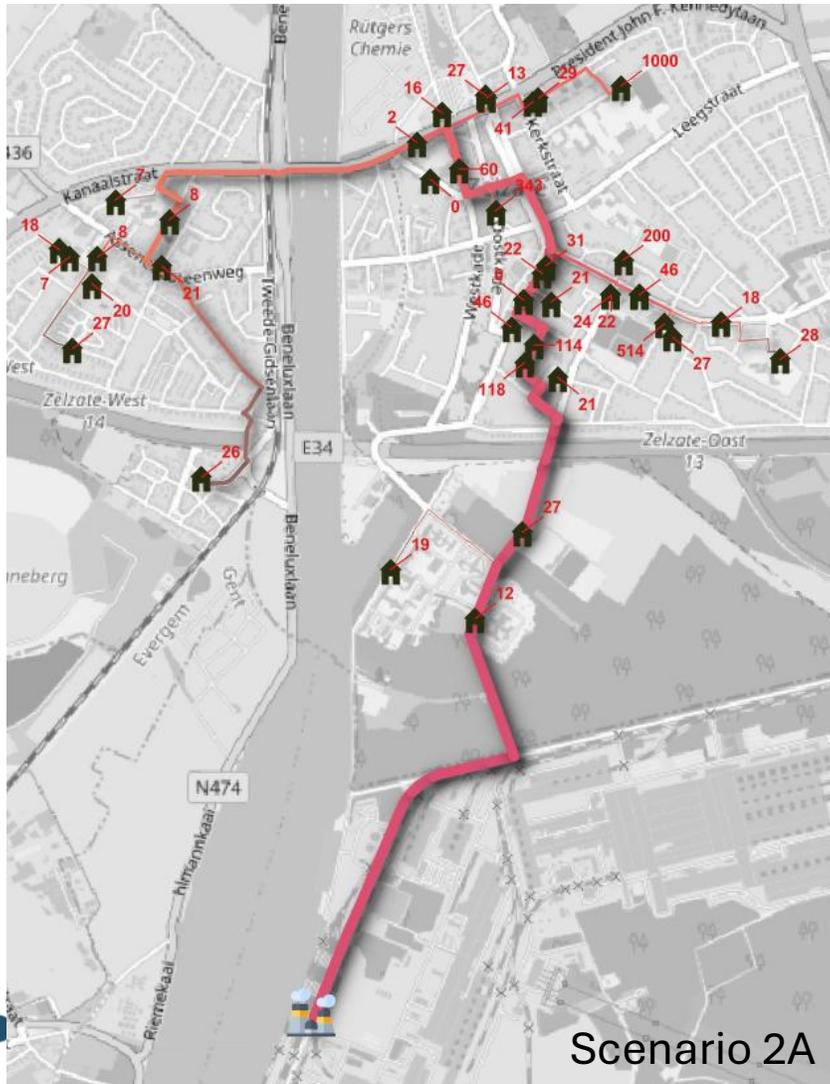
7: incl. STORM – 5 biggest heat consumers 40% reduction in peak power



Assumptions

- Default cost of heat: 0.01 ct/kWh
- Heat capex: 300.000 €/MW
- Default cost of electricity: 11 ct/kWh
- Pump capex: 100 €/kWh
- Pipe diameters considered: DN 0 – 32 – 65 – 100 – 150 – 200 – 300 – 400
- Pipe prizes: €/m 0 – 202 – 218 – 258 – 448 – 461 – 665 – 922
- Trenching cost: 400 €/m
- Non-linear model using turbulent flow
- Peak demand dimensioning with 100% thermal demand satisfaction
- Maximum pressure drop allowed: 12 bar
- Supply temperature at producer: 75 °C
- Minimal supply temperature: 60 °C
- Project horizon: 30 years
- IRR: 5%
- **Optimization towards minimal Total Cost of Ownership**

PathOpt - results optimal typology



Scenario 2A



Scenario 3

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Scenario 4

PathOpt – conclusions



- PathOpt is a non-linear automatic optimization framework to define optimal DH network typologies (routing + diameters)
- PathOpt was applied in HURRICANE to analyse DH design scenarios for the excess heat of AMB
- 'Left bank only' turns out the cheapest (CAPEX & TCO), then 'right bank only', then 'all' scenario
- 50% heat density reduction increases the minimal heat price by ~25%
- Next steps:
 - Refinement of the assumptions for scenario analyses
 - Assess the effect of peak shaving controllers (such as STORM) on the network design



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Harnessing Industrial Waste Heat for Resource Efficiency and Circular Economy

We are dedicated to transforming the industrial landscape through innovative solutions that promote energy efficiency, water efficiency, and circularity.

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HURRICANE Project

Sector-coupling hub for circular use of thermal and industrial waste | EU-funded Horizon Europe Project
Research Services · Ghent · 110 followers · 11-50 employees

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Overview

HURRICANE transforms traditional steelmaking plants into multi-sectoral circular hubs, pioneering a sector-coupling initiative at the Ghent site of ArcelorMittal Belgium. Our mission: revolutionize industrial resource management through innovative waste heat recovery and utilization.

We aim to reduce energy, water, and raw material consumption through novel heat recovery solutions and district heating networks, connecting industry with local communities.

Website: www.hurricane-hub.eu

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Website
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Thank you!

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